



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|-----------------|-------------|----------------------|---------------------|------------------|
| 10/813,176 | 03/31/2004 | Masatomo Shibata | Q80822 | 4446 |

23373 7590 03/02/2007
SUGHRUE MION, PLLC
2100 PENNSYLVANIA AVENUE, N.W.
SUITE 800
WASHINGTON, DC 20037

| |
|----------|
| EXAMINER |
|----------|

DOLAN, JENNIFER M

| | |
|----------|--------------|
| ART UNIT | PAPER NUMBER |
|----------|--------------|

2813

| SHORTENED STATUTORY PERIOD OF RESPONSE | MAIL DATE | DELIVERY MODE |
|--|------------|---------------|
| 3 MONTHS | 03/02/2007 | PAPER |

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary

Application No.

10/813,176

Applicant(s)

SHIBATA, MASATOMO

Examiner

Jennifer M. Dolan

Art Unit

2813

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 December 2006.
2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,10,13,17-24 and 46-55 is/are pending in the application.
4a) Of the above claim(s) _____ is/are withdrawn from consideration.
5) ☐ Claim(s) _____ is/are allowed.
6) ☒ Claim(s) 1,2,10,13,17-24 and 46-55 is/are rejected.
7) ☐ Claim(s) _____ is/are objected to.
8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
10) ☒ The drawing(s) filed on 13 August 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 1, 10, 13, 22, 23, 47, 53, and 54 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent Publication No. 2003/0134493 to Cho et al.

Regarding claims 1, 10, 13, and 47, Cho discloses a self-supported III-V nitride semiconductor substrate (paragraphs 0011, 0023 – GaN substrate or wafer) having a substantially uniform carrier concentration distribution throughout the wafer and through substantially any thickness (paragraph 0025 – “extreme uniformity of doping”; since the doping is considered to be uniform, the substrate inherently should not have high-brightness and low-brightness regions). Cho further discloses carrier concentrations both exceeding $1 \times 10^{17} / \text{cm}^3$ and less than $1 \times 10^{17} / \text{cm}^3$. Since Cho specifically states that the concentration throughout the GaN substrate is extremely uniform (paragraph 0025), it is expected that the concentration variances would be very small, and hence, within the claimed ranges.

Art Unit: 2813

Regarding claims 22, 23, 53, and 54, Cho discloses that the substrate is GaN doped with an impurity (paragraphs 0023-0028).

3. Claims 1, 2, 10, 13, 17-24, 46-55 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent Publication No. 2002/0046693 to Kiyoku et al.

Regarding claims 1, 2, 10, 13, 19, 46, 50, Kiyoku discloses a self-supported III-V nitride semiconductor substrate (17 or 116, see figures 5A-> 5B, paragraphs 0102-0103) having a substantially uniform carrier concentration distribution (see paragraph 0070) and thus no high or low brightness regions, throughout the self-supported layer (see paragraphs 0065, 0067, 0072, 0077, 0085, 0096-0099, noting that the method employed by Kiyoku involves forming a selective growth mask, growing a nitride layer in the apertures, laterally overgrowing the nitride layer across the top of the SiN layer until a flat surface is formed, and then continuing the growth of the self-supported III-V nitride layer – see paragraphs 0038-0039, 0059, 0067, figures 1c and 5; This method is considered substantially similar to the Applicant's 'Example 5' method, and thus should have similar resultant properties. The Examiner further notes that Kiyoku discloses that the upper layers 17 or 116 are made substantially defect free, and thus, should not exhibit variances in carrier uniformity resulting from pitting of the layer; also see Examples 2, 3, 5, 15, paragraphs 0145-0159, -230-0234). Kiyoku further discloses that the carrier concentration is in the range of $5 \times 10^{16} - 5 \times 10^{21} / \text{cm}^3$ (see paragraph 0070) and that layer 17 has a thickness of up to about 1 mm (see paragraph 0068, 0103). Since Kiyoku uses substantially similar methodology as the Applicant, and since Kiyoku shows that the pitting and defect density of the layer is very

small (paragraphs 0072, 0077, Examples 2-5), it is inherently the case that the carrier concentration variation would be very small, and thus within the claimed ranges.

Regarding claims 17, 18, 48, and 49, Kiyoku discloses polishing the top and bottom surfaces (paragraph 0148, 0152, 0233).

Regarding claims 20, and 51 Kiyoku discloses growth on a C-plane, which is a (0001) plane (see paragraph 0054).

Regarding claims 21, 47, and 52, Kiyoku discloses a lower dislocation density on a top surface than on a bottom surface (see figures 5A-5B, 6A-6C; defects on the bottom surface terminate to form a smooth upper surface; also see paragraph 0308).

Regarding claims 22, 23, 53, and 54, Kiyoku discloses that the substrate is a doped GaN or AlGaN material (paragraphs 0035, 0070, 0077)

Regarding claims 24 and 55, Kiyoku discloses that the III-V crystal may be grown by HVPE (paragraph 0058).

Response to Arguments

4. Applicant's arguments filed 15 December 2006 have been fully considered but they are not persuasive.

Regarding Cho: (US 2003/0134493):

The Applicant argues that Cho is silent as to the uniform surface carrier concentration, and thus does not disclose a carrier concentration of within 25 %. The Applicant further argues that uniformity in Cho would result from initial non-uniform carrier concentrations as well as impurities from furnace growth of the crystal.

This is not persuasive, because Cho specifically states that the doping method results in “rather extreme uniformity of doping of impurities regardless of material thickness” (see paragraph 0025). A person skilled in the art would not consider carrier concentration variations of greater than 25 percent to have “rather extreme uniformity.” Ergo, it is apparent that the method in Cho must result in uniformity within the claimed ranges. Additionally, since the GaN is not intentionally doped prior to the neutron transmission doping, but rather the doping results from transmuting the Ga in the GaN lattice into Ge, it is readily understood by a person skilled in the art that while some non-intentional incorporation of dopant materials will occur, such doping levels are expected to be well below the carrier concentration of around $1 \times 10^{17} / \text{cm}^3$, and thus should not significantly affect the uniformity of the carrier concentrations.

Regarding Kiyoku (US 2002/0046693):

The Applicant argues that Kiyoku is silent regarding a uniform carrier concentration distribution. The Applicant further argues that Kiyoku is not similar to the present application, since Kiyoku does not teach a step of making the growth interface become flat in the course of the crystal growth process, followed by a growth of the III-V nitride while maintaining a state of flatness.

This is not persuasive, because Kiyoku does disclose a step of performing lateral overgrowth over a selective growth mask layer, wherein the laterally overgrown portions merge to form a flat interface having substantially few defects (see paragraphs 0038-0039, 0059, 0067; figure 1c). After layer 16 is made flat, layer 17 is grown thereon, wherein layer 17 has very few crystal defects, and thus high uniformity (see in particular, paragraphs 0039 and 0067).

Art Unit: 2813

Alternatively, since layers 16 and 17 are continuously grown, at some point, the surface must be considered “flattened”, such that the upper portion of layer 16 in addition to layer 17 are considered the substantially uniform layer. Since both the Applicant’s method and that in Kiyoku teach formation of a selective growth mask, epitaxial lateral overgrowth of GaN to bury the selective growth mask, the growth, at some point in the process, resulting in a substantially flat surface, and then continued growth of a GaN layer upon the flat surface, it appears to the Examiner that both methods must result in substantially the same uniformity.

Regarding Motoki (US 6,773,504):

The arguments are moot, based on the withdrawal of the rejections based on Motoki.

Conclusion

5. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

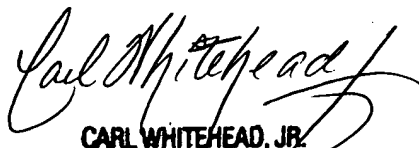
Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jennifer M. Dolan whose telephone number is (571) 272-1690. The examiner can normally be reached on Monday-Friday 8:30am-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead, Jr. can be reached on (571) 272-1702. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Jennifer M. Dolan
Examiner
Art Unit 2813

jmd


CARL WHITEHEAD, JR.
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800